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the apparatus used was of improved form originating with the author.

The Reinforcement and Inhibition of the Knee-jerk. H. P. BOWDITCH,
M. D. Boston Med. and Surg. Journal, May 31, 1888.

The interesting experiments of which this paper is a preliminary report, had for their object the study of the effect of time upon the reinforcement of the knee-jerk. They start from the well known fact that the knee-jerk is for a time reinforced when preceded by other muscular action. The subject, having taken his position, and been connected with the recording apparatus, at a bell signal, gripped a piece of wood with his right hand. The bell signal was followed at from zero to 1.7 seconds by a regulated blow on the patellar ligament producing the jerk. The experiments were made in courses of about an hour, each embracing several series. Each series was begun by a number of simple knee-jerks, to be used as a basis of comparison with the reinforced ones that followed. The difference between the averages of these parts of a single series was known as the *special reinforcement*; that between the second part of any series and the average of all the first parts of the same course was the *general reinforcement*. In the cut which represents graphically the results of 551 normal and 624 reinforced records on four subjects, the curves for the special and general reinforcements follow nearly the same course. If the hammer stroke was less than 0.4 sec. later than the signal for clinching the hand, the extent of the knee-jerk was increased; if it was more than 0.4 sec. later, the extent was less than normal, till at about 1.7 sec. it again became normal; that is to say, by a clinching of the hand, the spinal centres for the knee-jerk are first excited, then depressed, and then gradually return to their normal condition. Says Professor Bowditch: "We have in this alternating action a phenomenon which cannot fail to throw light upon the nature of 'inhibition,' and [is] destined perhaps, when fully understood, to establish the interference theory on a firm basis."

Ueber die Wahrnehmung der Geräusche. ERNST BRÜCKE. Wien. Sitzb.
3te Abth., XC (1884), pp. 199-230.

On the ground of certain experiments, Exner published the conclusion, in 1876, that we hear tones and noise with the same organs. The present paper is a further study of the same question, made by the author in connection with Profs. Exner and Fleischl. If this conclusion is true, and both are perceived with the same structure of the ear, they should show points of similarity. And such they do, both in common experience (witness the representation of cannonading by drum strokes), and in suitable experiments more clearly still. Experiments were begun on explosive noises as the simplest. Having adapted a flame and rotating mirror to the study of such sound waves, the author first tried the report given in forcing a rubber stopper out of lead tubes of various lengths by compressed air, which proved to be a series of waves of decreasing intensity; and later, the explosion of soap-bubbles of hydrogen and air, which gave a solitary wave. Discriminations of high and low could be made with both, corresponding with the length of the tube and the size of the bubble, as should be the case if the noises are heard with

the tonal apparatus of the ear. It was further proved that a series of short and sharp sounds like those of a watchman's rattle, provided all extra accompanying sounds were fully damped, could be as rapid as 600 or more per second before producing an even tone. The corresponding parts of the ear leap into vibration at the first impulse, and as quickly subside. This makes possible a wide range of untonal sensations. If tone arises from continuous, even, and regular stimulation, noise arises from short, irregular and suddenly varying stimulation; and the two classes of sound pass into one another by insensible gradations. The complex noises, rustling, hissing, blowing, etc., can be reduced to noises as simple as those tested, differently combined, varied in quality, intensity and rapidity, and accompanied in differing degree by true tone. These experiments do not exclude the possibility of special organs for noise-hearing, but they seem to make their assumption, which is attended with difficulties, unnecessary.

Ein Kinesiæsthesiometer, nebst einigen Bemerkungen über den Muskelsinn. E. HITZIG. *Neurol. Centralblatt*, May 1 and 15, 1888.

The kinesiæsthesiometer, less formidable than its name might suggest, is a set of 17 wooden balls for testing "muscle-sense." The balls are about 7 cm. in diameter, and graded from 50 to 100 grs. by 10's, from 100 to 300 by 50's, and from 300 to 1000 by 100's. For use with the lower extremities, a stocking is provided with a pocket at the heel for the reception of the balls, the patient lying on his back during the experiment. The advantages of this device over others mentioned by the author consist in its easy and speedy application and in its portability. Previous measurements of the fineness of discrimination are discussed, and one tenth, the smallest difference for which this apparatus is adjusted, is taken as about the limit of sure discrimination with the upper extremities for normal subjects, and thus as an appropriate starting point for testing those whose sensibility is blunted by disease. For the lower extremities the limit is one tenth or more.

A large portion of the paper is taken up with a discussion of what is really measured in tests of this kind, and particularly of the hypothesis of a special central *Kraftsinn*. The author is not opposed to such an hypothesis—in fact, does not see how voluntary motion is to be explained without it—but at the same time does not believe that it is necessarily a conscious sensation, nor independent of the centripetal sensations from muscle, skin, and joint. He adds an interesting critique of arguments pro and con, together with three cases from which such a sense might hastily be deduced, but which on closer examination are inconclusive. In such experiments he considers one measures the sensations of movement in the most general meaning of the word, hence the name of his instrument.

Grundlinien zur Erforschung des Helligkeits- und Farbensinnes der Tiere. VITUS GRABER. Prag, Temsky; Leipzig, Freytag. 1884, pp. 332.

The question of the color-sense of animals has been put into a new stage of development by the admirable experimental work of Vitus Gruber. His investigation has hardly received the attention which it deserves, and it seems worth while to give a summary of his results, although they are already four years old.